# Powder Coatings Troubleshooting Guide

## Tips and techniques for the application of PPG ENVIROCRON® Powder Coatings

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## Introduction

PPG is a global leading provider of coatings, paints and specialty materials, offering solutions in every major technology platform, including powder, liquid, electrocoat, pretreatment, as well as advanced energy curable solutions.

This Troubleshooting Guide explores possible causes and solutions of errors that can occur in the powder application and finishing process.

Please contact your local PPG representative for troubleshooting guides on other technologies.

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*The tips and techniques described herein are based upon the best information and practices known to PPG Industries, Inc. (“PPG”). Any statements or methods mentioned herein are general suggestions only and are not to be construed as representations or warranties as to safety, performance, or results. Since the resolution of issues is highly dependent on the product user’s processes, operations, and numerous other user-determined conditions, the user is solely responsible for, and assumes all responsibility, risk and liability arising from, the determination of whether the proposed solution is suitable for the user. Continuous improvements in coatings technology may cause future technical data to vary from what is in this bulletin. Contact your PPG representative for the most up to date information.*

# 1. Fluidization Bed

## 1.1. No Air Percolating

*No air is percolating through the powder surface.*

| Potential Cause | Solution Proposal |
|---|---|
| Insufficient air pressure | • Check air supply<br>• Increase air regulator pressure |
| Compacted powder | • Check air line size to equipment<br>• Fluidize the powder with clean/dry air |
| Fluid bottom defect | • Replace fluid bottom |
| Fluid bed clogged | • Clean fluid bed |

## 1.2. Stratification

*The powder is separating into layers of fine and coarse particles.*

| Potential Cause | Solution Proposal |
|---|---|
| Powder is too fine | • Adjust virgin / reclaim mixture |

## 1.3. Ratholing

*Air is blowing large jet holes into powder surface.*

| Potential Cause | Solution Proposal |
|---|---|
| Powder level too low | • Add powder (the hopper should be 2/3 full when fluidized) |
| Packed or moist powder | • Check compressed air and application room for moisture/high humidity |
| Broken or plugged membrane | • Check membrane for plugged pores from dirty air supply, cracks or holes |
| Powder too fine | • Adjust virgin / reclaim mixture |

## 1.4. Dusting / bubbling

*The powder is blowing out of the hopper / bubbles form on the surface.*

| Potential Cause | Solution Proposal |
|---|---|
| Air pressure supplying hopper too high | • Adjust air regulator pressure to fluid bed |
| Positive pressure in hopper | • Check venting for insufficient venting to the hopper |
| Powder too fine / too high proportion of fines coming from recovery | • Adjust virgin / reclaim mixture<br>• Check air balance of the cyclone |
| Vent obstructed/insufficient size | • Clean the vent tube<br>• Increase the size of the vent |

*Ratholing*

*Dusting / bubbling*

## 2. Hoses and Pumps

### 2.1. Sintering / agglomeration

*The powder is conveyed irregularly through the powder hose so that accumulations (agglomerates) form in it. These become visible as powder spatters on the work piece.*

| Potential Cause | Solution Proposal |
|---|---|
| Fine content of the powder coating too high | • Ensure correct particle size distribution<br>• Adjust virgin / reclaim mixture |
| Compressed air is moist or oil in compressed air | • Check cooling dryer and ultra-fine filter |
| Dosing air proportion too low | • Reduce powder quantity, increase total air quantity |
| Unfavorable hose routing | • Avoid kinks and tight curve radii |
| Hose constriction | • Check the hose for constrictions caused by cable ties or similar. |
| Hose too long | • Shorten hose or increase total air volume |
| Hose diameter too small | • Select larger diameter for increased powder output |
| Ground out tab nozzle | • Replace tab nozzle |
| Electrode is covered | • Increase purge air |

## 2.2. Plugged hoses

*Hoses and pumps are plugged from impact fusion.*

| Potential Cause | Solution Proposal |
|---|---|
| Normal build-up / routine maintenance not being done | • Clean or replace parts<br>• Set standard procedure for maintenance |
| Air pressure too high | • Use lower air pressure settings on gun and transfer pumps |
| Moisture in compressed air supply | • Check compressed air supply for clean, dry air |
| Powder is too fine | • Adjust virgin / reclaim mixture |

## 2.3. Powder feed to gun

*Insufficient or inconsistent powder feed to gun.*

| Potential Cause | Solution Proposal |
|---|---|
| Powder not fluidizing properly | • See Fluidizing Bed section |
| Insufficient air pressure or volume | • Check air supply for obstructions to increase the air pressure<br>• Check air supply lines for proper size<br>• See equipment specifications<br>• Increase atomizing air pressure |
| Obstruction in powder supply | • Check and clean pick-up tubes, pumps and hoses<br>• Check sieve screen for tears and proper operation<br>• Check powder supply for foreign materials |
| Hoses kinked, crushed or too long | • Replace deformed hose<br>• Avoid sharp bends<br>• Hoses should be as short as practical |
| Hoses, pumps, pick-up tubes, or guns clogged | • Check/clean hoses, pumps, pick-up tubes and guns<br>• Check compressed air for sufficient dryness<br>• Control humidity to the proper specification for your system |
| Worn pump venturies | • Replace worn parts<br>• Set standard procedure for maintenance |

*Hose routing too narrow*

*Proper hose routing*

# 3. Application

## 3.1. Build-up on the spray nozzle

*During coating, powder or effect agent accumulates at the nozzle slot.*

| Potential Cause | Solution Proposal |
|---|---|
| Wear of the nozzle wedge | • Check or change wedge |
| Powder output too high | • Reduce powder quantity |
| Powder too moist | • Check compressed air and application room for moisture/high humidity |
| Effect powder coating: electrostatic charge too high | • Remove discharge rings |
| Effect powder coating: incorrect powder hose | • Use grounded hose material |

*Build-up on the spray nozzle*

## 3.2. Poor charging, low film build, insufficient wrap

*Recommended layer thickness cannot be achieved; uneven coverage of the component.*

| Potential Cause | Solution Proposal |
|---|---|
| Low or no voltage at electrode | • Check for voltage at electrode, cable and power supply<br>• Replace missing or broken electrodes<br>• Clean build-up from electrodes |
| Poor ground | • Check ground from conveyor through hanger to part; adequate ground is less than 1 mega ohm<br>• Remove any build-up of insulating materials from conveyor and hangers |
| Powder delivery too low | • Increase powder flow |
| Powder output from guns too high reducing the charging efficiency | • Decrease powder output from guns until material is properly charged |
| Humidity too low (in case of Corona spraying) | • Control humidity to the proper specification for your system (40-60% RH) |
| Powder too fine | • Adjust virgin / reclaim mixture |

## 3.3. Poor penetration

*The powder will not coat in Faraday cage areas.*

| Potential Cause | Solution Proposal |
|---|---|
| Voltage: Intensity (µA) too high | • Reduce Intensity (µA) so that powder builds on edges evenly and does not repel corners |
| Powder / air velocity too high | • Reduce air pressure so that powder does not blow out of recesses |
| Poor ground | • Check suspension<br>• Check for adequate ground not to exceed 1 mega ohm |
| Improper technique or gun placement | • Adjust gun so that powder is directed at surfaces adjacent to the corners |
| Improper spray pattern | • Select different nozzle or deflector<br>• See your equipment manufacturer |
| Powder too fine | • Adjust virgin / reclaim mixture |
| Part is too close or too far from spray gun | • Reduce or increase distance |

## 3.4. Powder repelling from part

*The powder does not adhere to the surface or it partly falls away.*

| Potential Cause | Solution Proposal |
|---|---|
| Poor ground | • Check contacts and hooks<br>• Check for adequate ground |
| Charge too low | • Increase voltage |
| Powder output too high | • Reduce powder output |
| Powder too fine | • Adjust virgin / reclaim mixture |
| Fluidity too high | • Contact the powder coating supplier |
| Film thickness too high | • Reduce film thickness |
| Blow-off effect due to too much conveying air or insufficient distance to the part | • Reduce air settings<br>• Increase distance to part |

## 3.5. Poor spray pattern

*The powder does not adhere to the surface or it partly falls away.*

| Potential Cause | Solution Proposal |
|---|---|
| Worn gun parts | • Replace worn nozzles, deflectors and electrode sleeves |
| Blockage from impact fusion | • Clean any impact fusion from parts; set standard procedure for maintenance |
| Hoses, pumps, pick-up tubes or guns clogged | • Check/clean hoses, pumps, pick-up tubes and guns<br>• Check compressed air for sufficient dryness<br>• Control humidity to the proper specification for your system |

## 3.6. Layer thickness too high

*The coating surface shows a tendency to orange peel after curing. Pinholes are also possible.*

| Potential Cause | Solution Proposal |
|---|---|
| Part too hot | • Allow part to cool for longer |
| Powder output too high | • Reduce powder output |
| Application time too long | • Shorten application time |
| Insufficient distance to part | • Increase distance to part |

## 3.7. Layer thickness too low

*The substrate is visible after curing; grainy surface finish.*

| Potential Cause | Solution Proposal |
|---|---|
| Poor grounding | • Check hooks and clean if necessary<br>• Measure grounding |
| Powder output too low | • Increase powder output |
| Powder charge too low | • Optimize voltage |
| Application time too short | • Increase application time<br>• Reduce conveyor speed (if automatic line) |
| Distance to part too large | • Decrease distance to part |
| Improper or too long hose material | • Select grounded hose<br>• Shorten hose or change hose diameter |

## 3.8. Layer thickness fluctuating

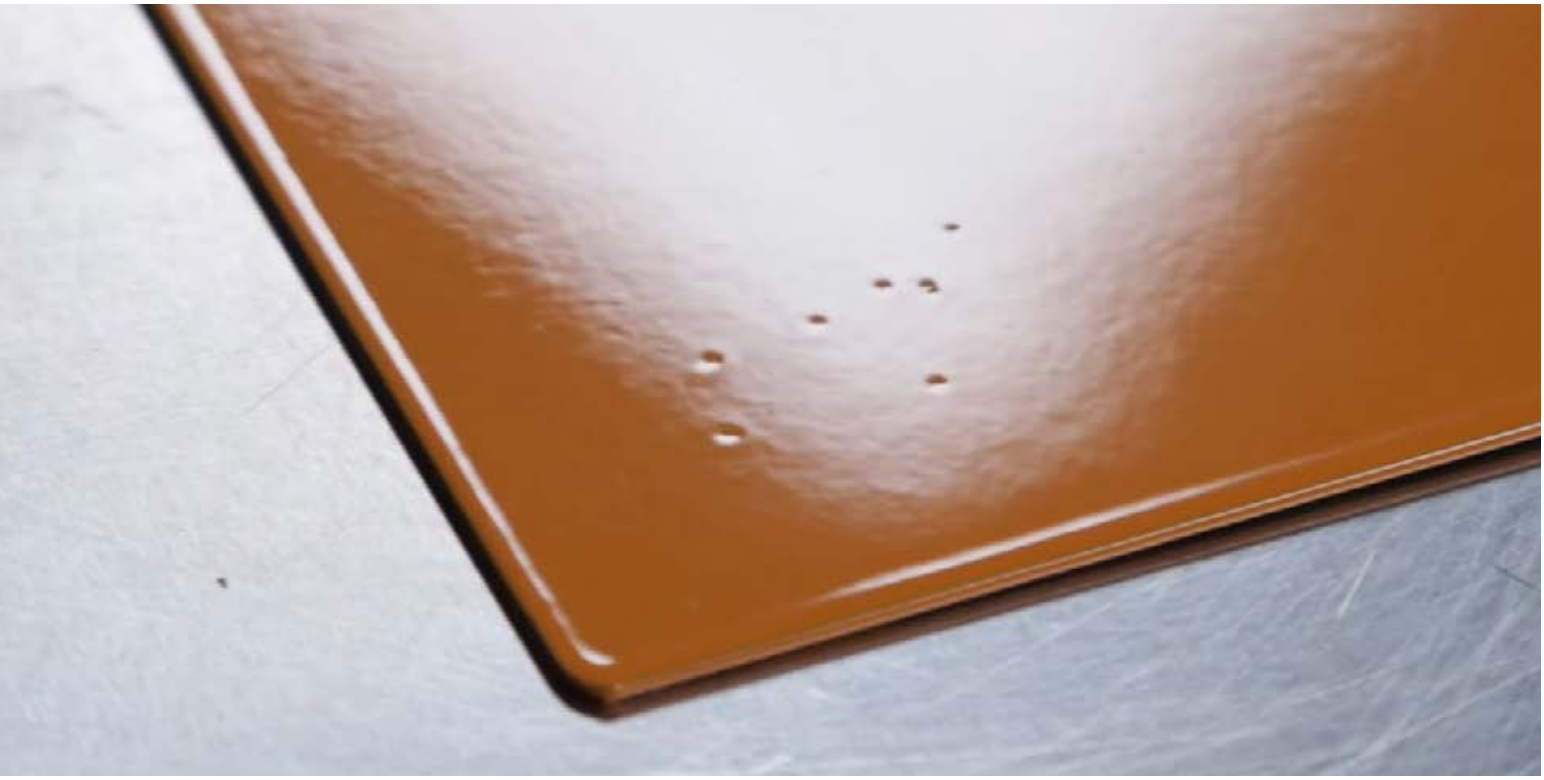
*Irregular layer thickness on the component that is visible or only measurable.*

| Potential Cause | Solution Proposal |
|---|---|
| Poor grounding | • Check hooks and clean if necessary<br>• Measure grounding |
| Irregular powder output | • Check fluidization, powder hoses and tab nozzles |
| Irregular manual application | • Train staff |
| Automatic application: irregular gun spacing, incorrect stroke setting, wrong sine curve, etc. | • Measure and adjust distances between guns<br>• Adjust stroke<br>• Optimize sine curve of automatic guns |

## 3.9. Lump formation / agglomeration in the cardboard box

*Lump formation in the cardboard box or fluid container.*

| Potential Cause | Solution Proposal |
|---|---|
| Storage Temperature and humidity at storage location too high | • Reduce storage temperature<br>• Sieve powder coating |
| Temperature and humidity during transportation too high | • Check powder for humidity<br>• Observe temperature during transportation |
| Pressure during storage too high | • Don't stack powder bags |
| Expiry date of the powder is exceeded | • Use new material |
| Conveying from cardboard box | • Use vibrating floor only when necessary |
| Poor quality powder coating | • Contact the powder coating supplier |

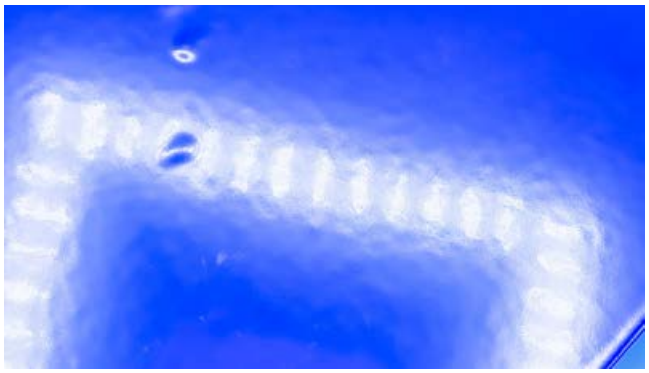


# 4. Surface Defects

## 4.1. Powder spouts

*Powder accumulations visible on the paint surface as localized elevations.*

| Potential Cause | Solution Proposal |
|---|---|
| Poor fluidization of powder | • Increase fluid air<br>• Contact paint manufacturer |
| Incorrect ratio of conveying air to dosing air | • Check the application settings |
| Sintering in hoses | • See section 3.1. |
| Build-up on the spray nozzle | • See section 4.1. |



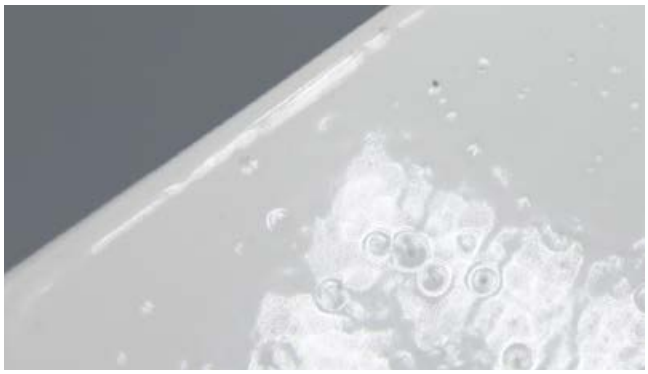
*Spouts*

*Spouts under a microscope*

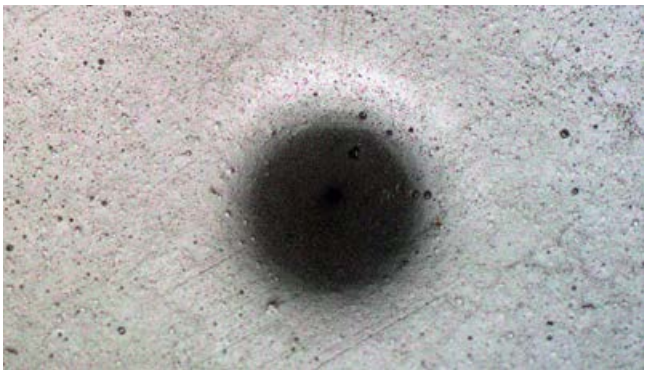
## 4.2. Craters

*Crater-shaped depressions partly reaching the substrate, upstanding rim.*

| Potential Cause | Solution Proposal |
|---|---|
| Oil or moisture in air lines | • Inspect air lines and, if necessary, install filters |
| Contamination with incompatible materials | • Inspect for presence of incompatible materials throughout the process |
| Contamination with incompatible powder | • Clean guns, hoses and hoppers<br>• Use virgin powder<br>• Check back sample |
| Inadequate cleaning or pretreatment, chemical residues | • Check pretreatment equipment and concentrations<br>• Consult pretreatment supplier |
| Degassing from the substrate e.g. due to galvanization or residual moisture on the components | • Tempering<br>• Preheat parts without powder |
| Overcoating of filler and liquid coating | • Check compatibility<br>• Tempering |



*Crater*

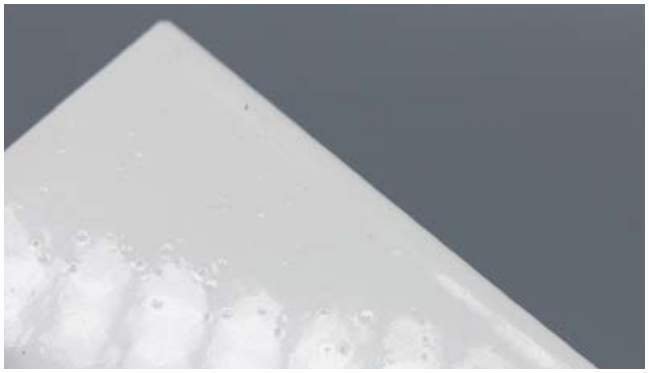


*Crater under a microscope*

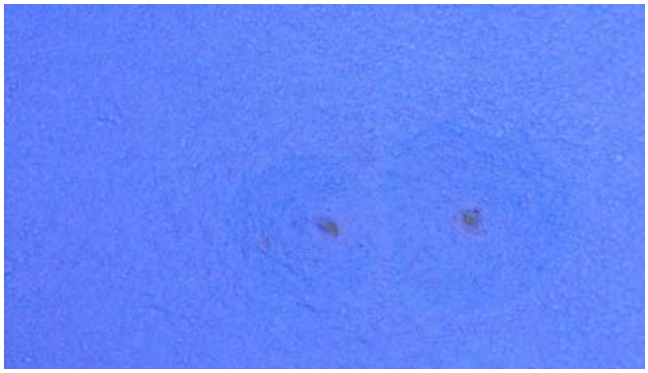
## 4.3. Pinholes

*Fine holes (pores) in the paint surface with a flat rim.*

| Potential Cause | Solution Proposal |
|---|---|
| Moisture in compressed air or powder | • Check for moisture in compressed air or powder |
| Residual moisture on the substrate | • Observe dew point<br>• Ensure that the substrate is at room temperature |
| Film thickness too high | • Decrease film build by using lower voltage, shorter spray time or a less dense powder cloud |
| Oven / object temperature too high | • Reduce oven temperature and/or time in oven |
| Substrate porosity | • Check substrate for porosity and adjust accordingly |
| Contamination with incompatible powder | • Clean guns, hoses and hoppers; use virgin powder<br>• Check back sample |



*Pinholes*

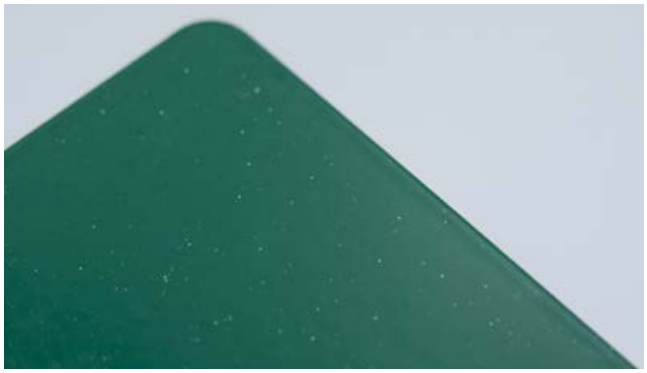


*Pinholes under microscope*

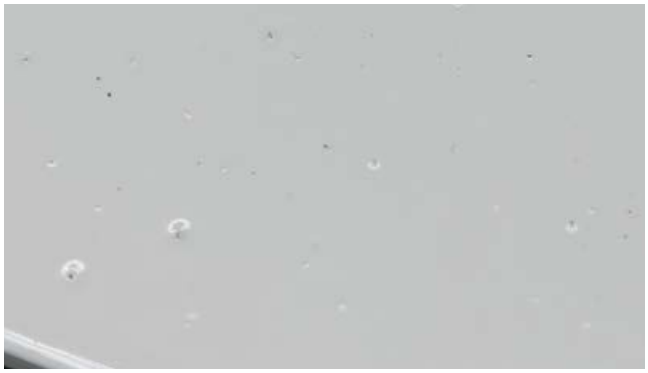
## 4.4. Contamination

*Foreign particles in the powder surface.*

| Potential Cause | Solution Proposal |
|---|---|
| Contamination of the conveyor, oven or surroundings | • Clean the booth, the oven and the conveyor regularly |
| Agglomerates or impurities in the powder coating | • Check back sample, in case of color dots ask for previous color shade used on the line |
| Fibers from cleaning cloths, work clothes, etc. | • Use suitable materials |
| Contamination from parts entering spray booth | • Check cleaning and pretreatment steps<br>• Ensure correct parts drying before entering the spray booth |
| Line sieve screen torn | • Replace sieve screen |



*General contamination*



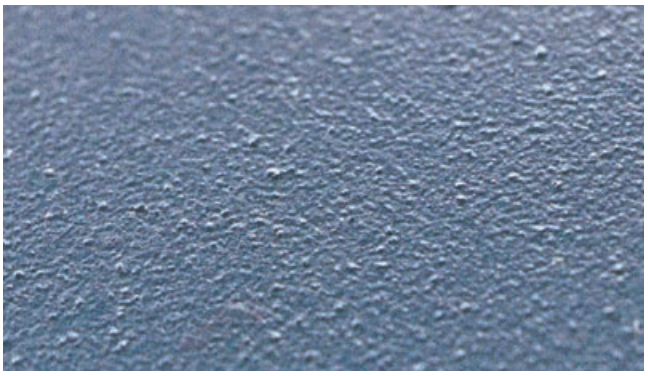
*Contamination due to dirt*

*Contamination due to fibers (microscope)*

## 4.5. Blisters

*Visible blisters or large craters due to burst blisters.*

| Potential Cause | Solution Proposal |
|---|---|
| Inadequate cleaning or pretreatment (water, oil, grease or pretreatment residues on substrate) | • Thoroughly dry/clean work pieces<br>• Check pretreatment equipment and concentrations<br>• Consult pretreatment supplier |
| Degassing due to casting or zinc | • Tempering<br>• Curing parts beforehand without powder<br>• Ensure correct galvanization/pre-treatment |
| Overcoating of liquid layers | • Ensure that the substrate is dry and suitable for powder coating. |



*Blisters*

## 4.6. Frame effect

*Higher layer thickness at the component edges leading to an inconsistent appearance.*

| Potential Cause | Solution Proposal |
|---|---|
| Gun voltage too high | • Use lower voltage |
| Gun is too close or too far from component | • Adjust and optimize distance between component and gun |
| Excessive conveying air or powder output | • Optimize powder output |

## 4.7. Drop formation

*Thick frames or drops form at the component edges.*

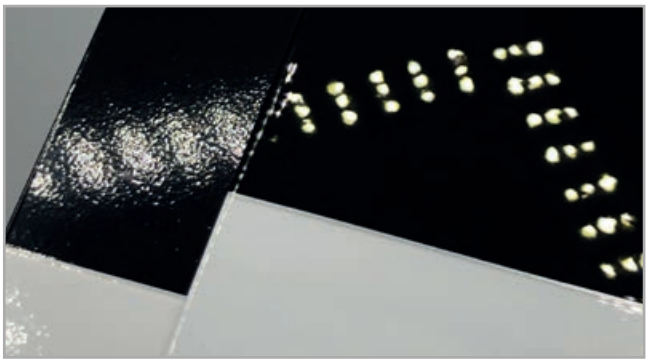
| Potential Cause | Solution Proposal |
|---|---|
| Film thickness too high | • Reduce film thickness |
| Oven / object temperature too high | • Reduce oven temperature |
| Component edges too sharp | • Deburr edges |

*Drop formation*

## 4.8 Orange peel

*Poor surface appearance (like an orange peel).*

| Potential Cause | Solution Proposal |
|---|---|
| Film thickness too low | • Increase film by using higher voltage, longer spray time or a more dense powder cloud |
| Film thickness too high | • Decrease film build by using lower voltage, shorter spray time or a less dense powder cloud |
| Powder too fine | • Adjust virgin / reclaim mix |
| Oven temperature too high | • Reduce oven temperature and/or time in oven |
| Too slow heating rate | • Determine curing curve |
| Powder too reactive, powder has pre-reacted | • Consult paint manufacturer |
| Structured substrate surface | • Consult substrate manufacturer |
| Voltage too high (KV) | • Reduce voltage (max. 50-70 KV) |
| Voltage too high - back ionization effect | • Reduce voltage |



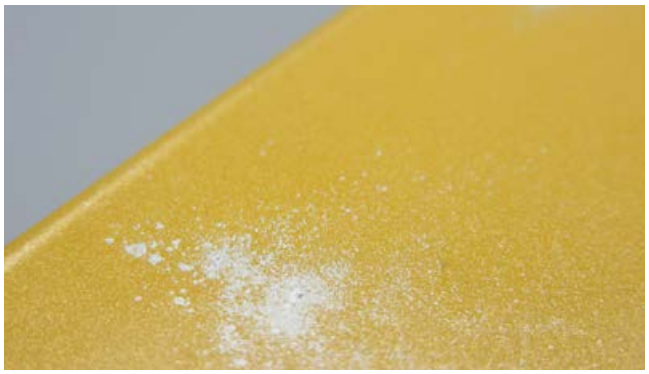
*Orange peel vs. smooth surface*

## 4.9. Wetting irregularities

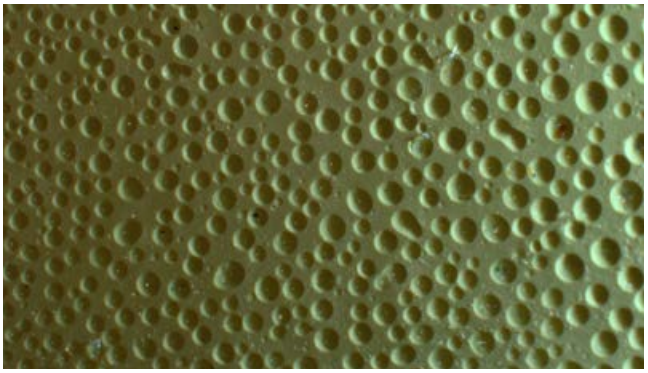
*Poor or no adhesion of the powder coating to the part surface, detachment of the cured powder coating.*

| Potential Cause | Solution Proposal |
|---|---|
| Oil or release agent on the surface, residues of pre-treatment | • Check pre-treatment ( nozzles of the VE sink )<br>• Eliminate scooping parts |
| Hand sweat or hand cream on the surface | • Use gloves when touching the parts after pretreatment |
| Powder coating over-cured | • Consider curing parameters |

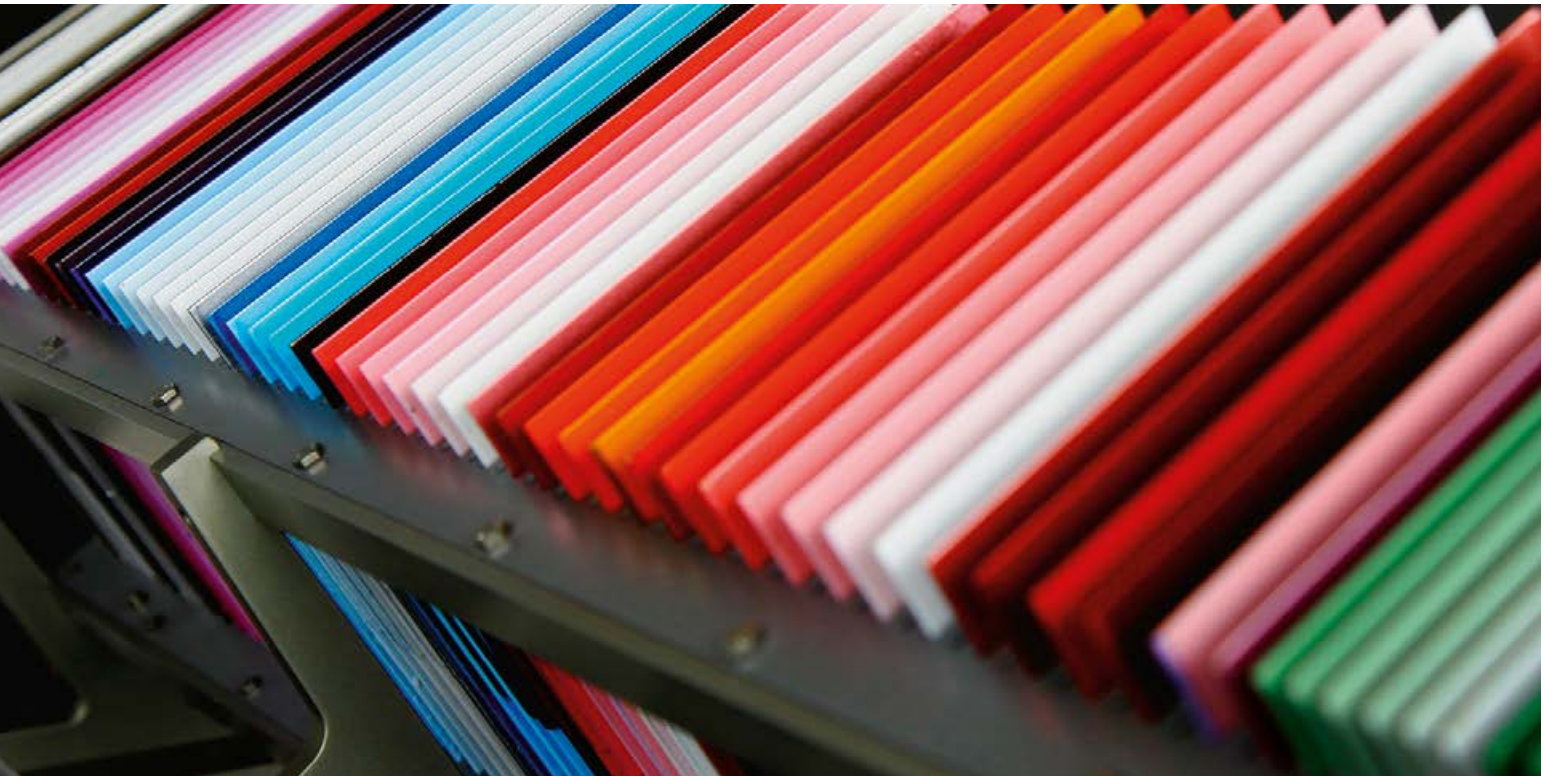
*Powder coating is not adhering at the edges*



*Wetting irregularities*



*Wetting disorders under a microscope*



# 5. Surface Deviations

## 5.1. Color and gloss deviations

*Deviations in color shade and/or gloss level between parts.*

| Potential Cause | Solution Proposal |
|---|---|
| Film thickness too low (substrate shining through) | • Ensure proper film thickness |
| Fluctuating film thickness | • Check gun arrangement<br>• Check sine curve for automatic cab |
| Overcuring / undercuring | • Run oven profile to determine if recommended time at temperature is achieved<br>• Increase / decrease oven temperature or line speed |
| Contamination from incompatible powders | • Clean guns, hoses and hoppers<br>• Use virgin powder |
| Different curing conditions of the similar parts | • Pay attention to the respective curing conditions |
| Parts with different wall thicknesses cured at the same time | • Adjust curing set-up<br>• Check oven settings |
| Degassing / micro-pinholing | • Check for moisture in compressed air or powder<br>• Check substrate for porosity |
| Improper oven exhaust | • Check for blockage in exhaust stacks<br>• Check for proper fan operation |
| Directly vs indirectly heated gas oven | • Use indirectly heated gas oven<br>• Ensure powder coating is suitable for direct heated gas ovens<br>• Add gas oven additive |

## 5.2. Yellowing

*Light colors turn yellow after curing.*

| Potential Cause | Solution Proposal |
|---|---|
| Curing parameters: Temperature too high and/or curing time too long | • Adjust curing parameters<br>• Check recommend curing parameters of powder coating |
| Usage of directly heated gas oven | • Use indirectly heated gas oven<br>• Ensure powder coating is suitable for direct heated gas ovens<br>• Add gas oven additive |
| Improper curing | • Check curing stability of powder coating |

*Yellowing due to overcuring*

## 5.3. Clouding

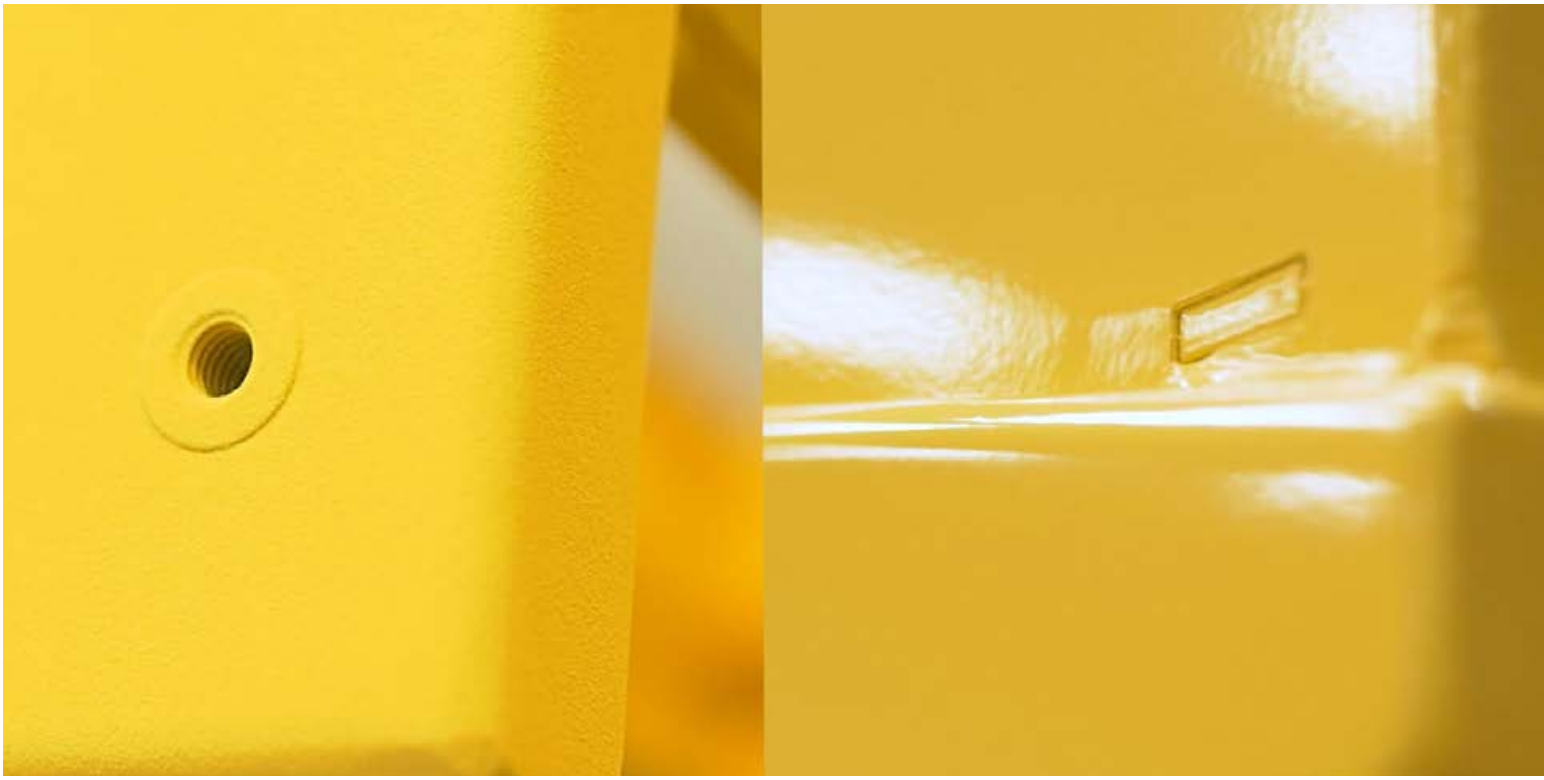
*Formation of visible stripes / clouds on the part's surface after curing.*

| Potential Cause | Solution Proposal |
|---|---|
| Insufficient distance between gun and part | • Increase distance |
| Irregular powder feed | • Ensure soft uniform powder cloud<br>• Train staff<br>• Add gas oven additive |
| Wrong sine curve | • Stroke height and speed and conveyor speed to be aligned with gun distance<br>• Consult equipment manufacturer |
| Fluctuating layer thickness | • Optimize layer thickness |

## 5.4. Lack of opacity

*Thick frames or drops form at the component edges.*

| Potential Cause | Solution Proposal |
|---|---|
| Film thickness too low | • Increase film thickness<br>• Check minimum film thickness |
| Inherent color of the substrate | • Increase film thickness |
| Surface structure of the substrate visible | • Reduce surface roughness<br>• More uniform pretreatment of the surface |
| Wrong equipment parameters | • Optimize equipment application parameters<br>• Consult equipment manufacturer if needed |



# 6. Cured Film Properties

## 6.1. Poor mechanical and chemical resistance

| Potential Cause | Solution Proposal |
|---|---|
| Powder coating is undercured | • Run oven profile to determine if recommended time at temperature is achieved<br>• Increase oven temperature / decrease line speed |
| Inadequate cleaning or pretreatment | • Check pretreatment equipment and concentrations<br>• Consult pretreatment supplier |
| Film thickness too high | • Lower film thickness by adjusting application equipment |

## 6.2. Poor adhesion

| Potential Cause | Solution Proposal |
|---|---|
| Powder coating is undercured | • Run oven profile to determine if recommended time at temperature is achieved<br>• Increase oven temperature / decrease line speed<br>• Lower film thickness by adjusting application equipment |
| Inadequate cleaning or pretreatment | • Check pretreatment equipment and concentrations<br>• Consult pretreatment supplier |

## 6.3. Poor corrosion resistance

| Potential Cause | Solution Proposal |
|---|---|
| Powder coating is undercured | • Run oven profile to determine if recommended time at temperature is achieved<br>• Increase oven temperature/decrease line speed |
| Inadequate cleaning or pretreatment | • Check pretreatment equipment and concentrations<br>• Consult pretreatment supplier |
| Film thickness too low | • Increase film thickness<br>• Check minimum film thickness |
| Poor edge coverage | • Contact your powder supplier |

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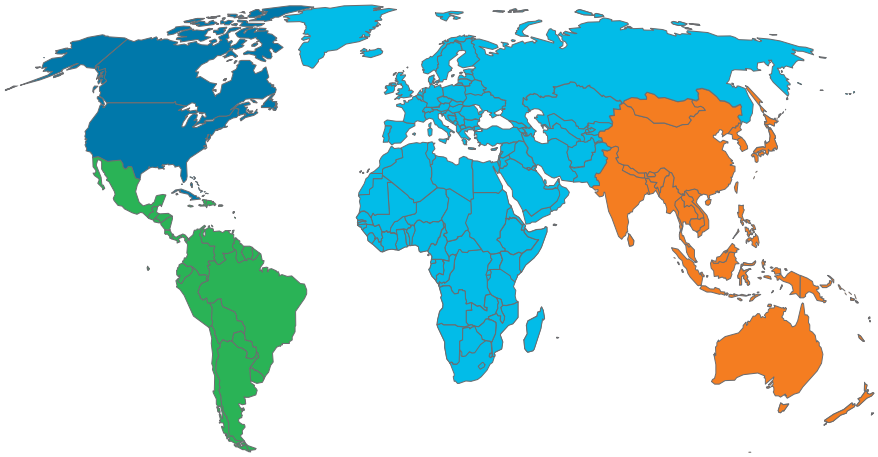

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